

# My Undergraduate Summer Research Award Experience

Angela Jiang

LabTREK 2023

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# About me:

Hi, my name is Angela Jiang!

- ▶ 2<sup>nd</sup> year science student (microbiology)
- ▶ Undergraduate Researcher for Dr. Sabine Kuss
- ▶ BIOL 1020 Teaching Assistant
- ▶ Communications programmer for the Science Students' Association (SSA)
- ▶ Undergraduate Summer Research Award Recipient 2023 (URA)



# The Laboratory for Bioanalytics and Electrochemical Sensing:



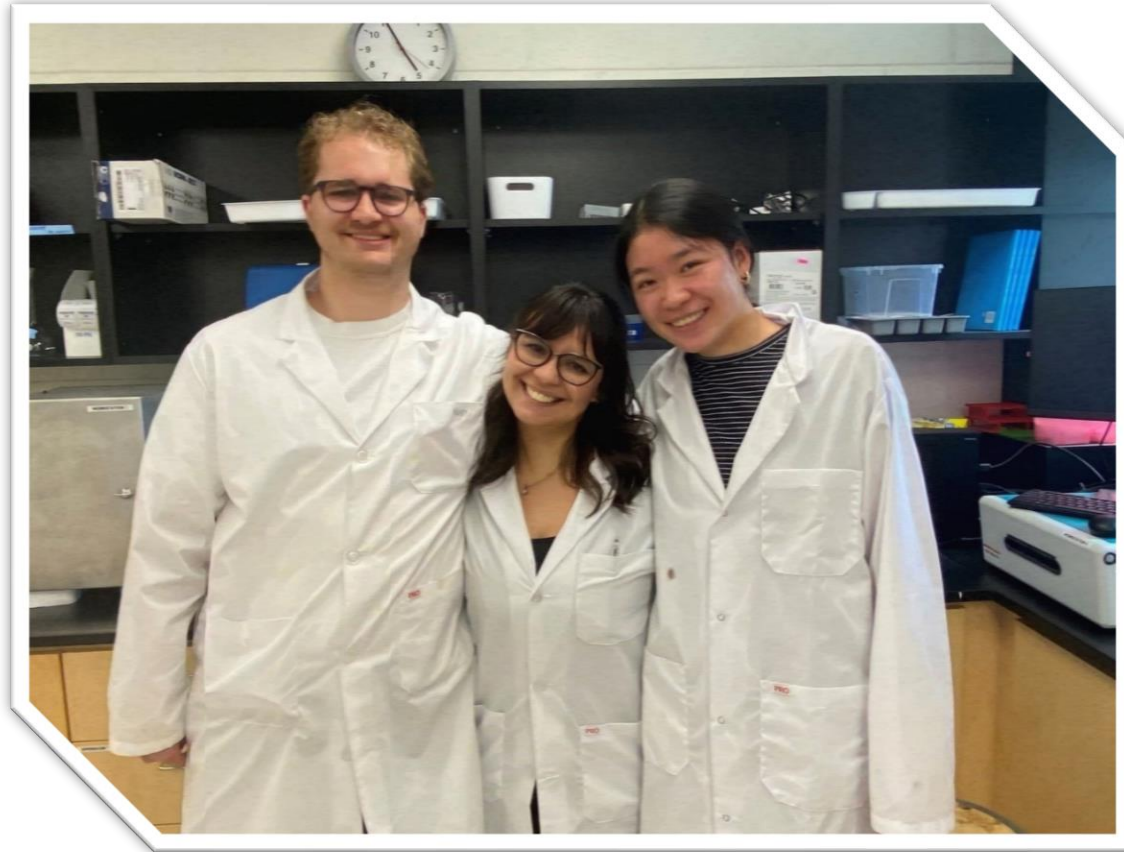
Dr. Sabine Kuss



Summer 2023-Kuss Group Photo

- ▶ Led by Dr. Sabine Kuss (Associate Professor, University of Manitoba)
- ▶ Lab focuses on using electrochemical techniques to investigate important questions in chemistry, biology and medical research.
  
- ▶ Connect with our research group!
  - ▶ Website: [www.bioanalyticschemistry.com](http://www.bioanalyticschemistry.com)
  - ▶ Twitter: @LBES\_UofM

Mentored by Luma Clarindo Lopes (Ph.D candidate, University of Manitoba)



L-R: Kolby Wiebe, Luma Clarindo Lopes, Angela Jiang



# My research (still in progress!):

Electrochemical Detection of Antibiotic Resistance in *Escherichia coli*.

**Electrochemical Detection of Antibiotic Resistance in *Escherichia coli***  
Angela Jiang, Luma Clarindo Lopes, Danyal Ramirez, Frank Schweizer, Sabine Kuss\*  
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**Introduction**

- In 2013, more than 2.2 million people died due to antibiotic-resistant bacterial infections<sup>1</sup>.
- Escherichia coli* (*E. coli*) is a bacterium that is commonly found in the gut of warm-blooded organisms, such as humans. While most strains of *E. coli* are harmless, some can cause severe foodborne diseases<sup>2</sup>.
- Tobramycin (TOB) is an aminoglycoside antibiotic that is used to treat *E. coli* infections. Unfortunately, many *E. coli* strains are resistant to TOB<sup>3</sup>.

Employing electrochemical techniques, the main goal of this project is to detect the TOB retention in *E. coli* cells with different degrees of resistance.

**Methodology**

- Strains of *E. coli*: EC 259, EC 107, EC 944
- Susceptibility to TOB: Resistant to TOB: Very Resistant to TOB (2 µg/96h), 128 µg/96h
- Incubation in TOB 2 ml for 23 minutes at 37 °C
- Control: EC 259, EC 107, EC 944
- Centrifugation for 20 minutes at 4000 rpm
- Adjusting the pH of the supernatants and control to 1 (adding HCl)
- Changes in TOB concentration in the supernatant solutions
- Differential pulse voltammetry (DPV)

**Results**

**Objective 1: Electrochemical optimization of Tobramycin detection**  
Methodology: Applying a potential at the surface of a glassy carbon working electrode (GCE) to generate the oxidation of TOB.

Figure 3. Cyclic voltammogram of a GCE in the absence and presence of added TOB in HCl pH 1.

Figure 4. Optimized DPV parameters were  $P_{100} = 50\text{mV}$ ,  $P_{10} = 5\text{mV}$ ,  $S_{10} = 30\text{mV}$  and  $S_{100} = 400\text{mV}$ . Standard DPV parameters were  $P_{10} = 3.3\text{mV}$ ,  $P_{100} = 100\text{mV}$ ,  $S_{10} = 5\text{mV}$  and  $S_{100} = 100\text{mV}$ .

DPV Parameters	-1	0	+1
Pulse height (mV)	30	40	50
Step height (mV)	30	40	50
Step Time (ms)	400	500	600

\*Pulse Width was fixed at 5ms.

**Current results for the optimization of DPV parameters**

Scan	Pulse Height (Step Height) (mV)	Step Time (ms)	Current (µA)
1	-1	-1	309.74
2	-1	-1	428.84
3	-1	-1	519.89
4	-1	-1	611.84
5	-1	-1	702.89
6	-1	-1	793.84
7	-1	-1	884.89
8	-1	-1	975.84
9	-1	-1	1066.89
10	-1	-1	1157.84
11	-1	-1	1248.89
12	-1	-1	1339.84
13	-1	-1	1430.89
14	-1	-1	1521.84
15	-1	-1	1612.89
16	-1	-1	1703.84
17	-1	-1	1794.89
18	-1	-1	1885.84
19	-1	-1	1976.89
20	-1	-1	2067.84
21	-1	-1	2158.89
22	-1	-1	2249.84
23	-1	-1	2340.89
24	-1	-1	2431.84

Figure 5. DPV parameters for the optimization of TOB detection. Pulse Width was fixed at 5ms.

**Objective 2: Electrochemical detection of Tobramycin uptake and retention**

Inhibition of drug uptake

Incubation of *E. coli* in TOB 2ml

Figure 6. DPV parameters for the optimization of TOB detection. Pulse Width was fixed at 5ms.

**Conclusions**

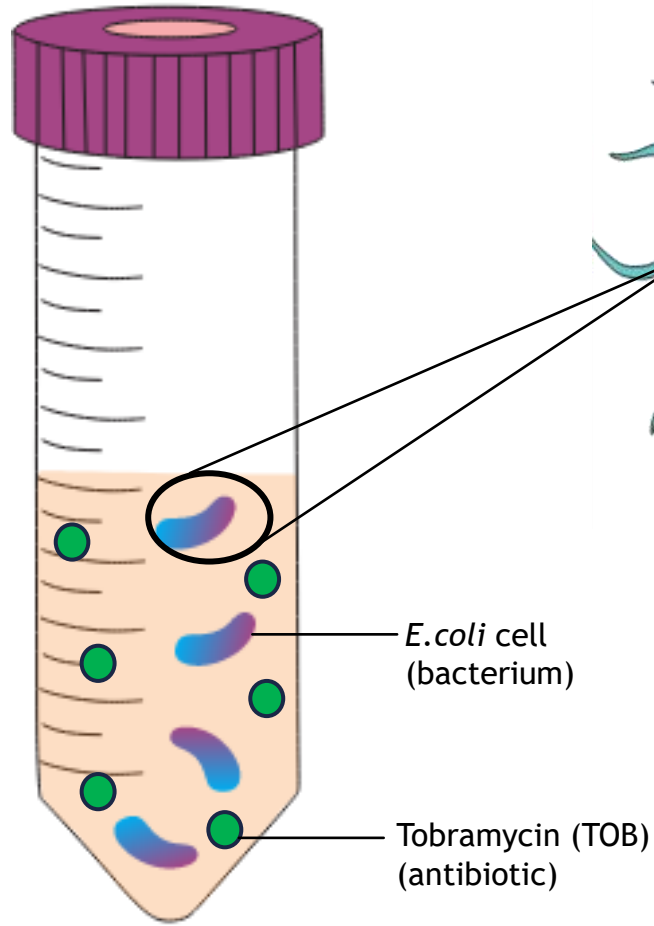
- The electrochemical oxidation of TOB is a reversible reaction with an oxidation peak at 0.8 V. This reaction is more favorable at pH 1.
- Optimal DPV parameters to detect TOB were  $P_{100} = 50\text{mV}$ ,  $P_{10} = 5\text{mV}$ ,  $S_{10} = 30\text{mV}$  and  $S_{100} = 400\text{mV}$ . In this optimization, the current increased by a factor of 47%.
- The proposed methodology successfully detects the TOB retention in *E. coli* cells with different degrees of resistance.
- As prospects, other *E. coli* strains will be used. Different incubation times and TOB concentrations will be further evaluated. More data will be collected for statistical analysis.

**References**

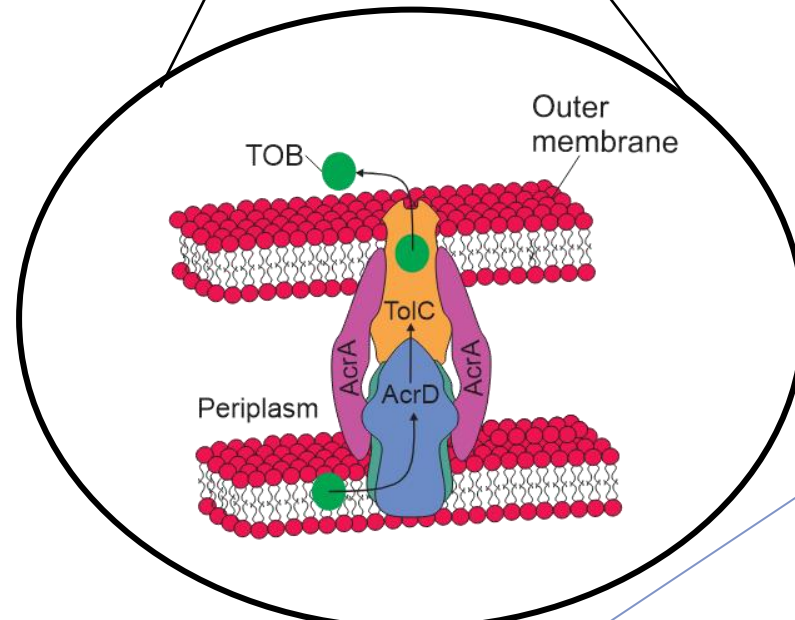
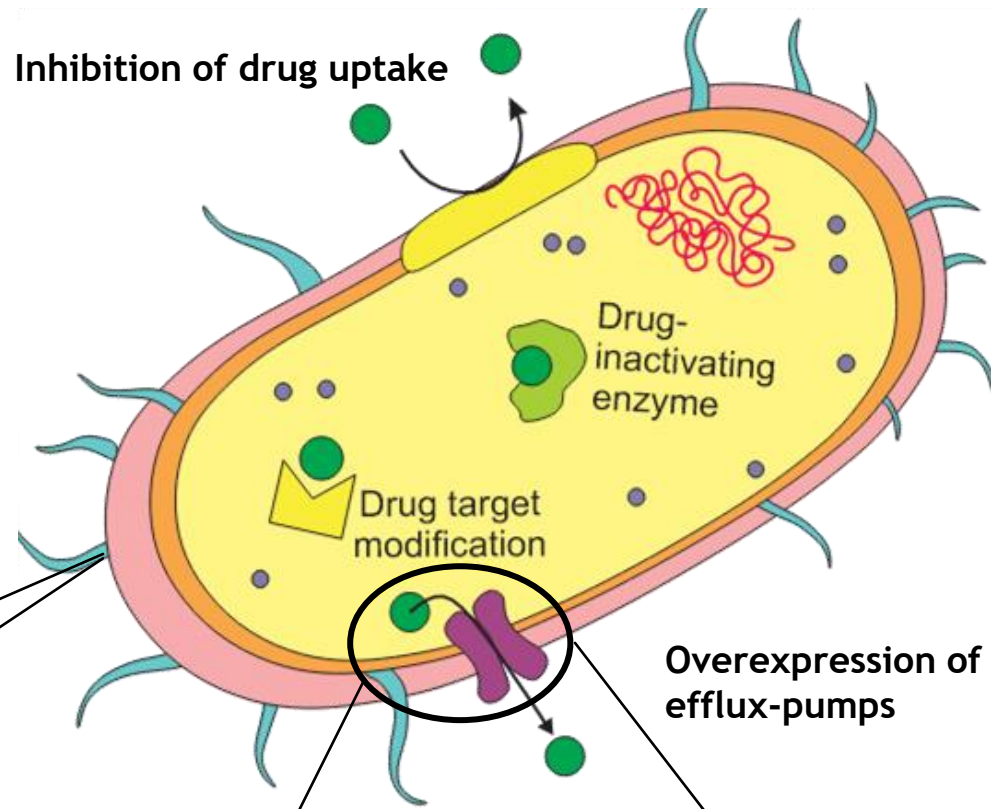
**Acknowledgments**

Summer 2023 - URA Poster Competition

Incubation of *E. coli* in TOB 2mM

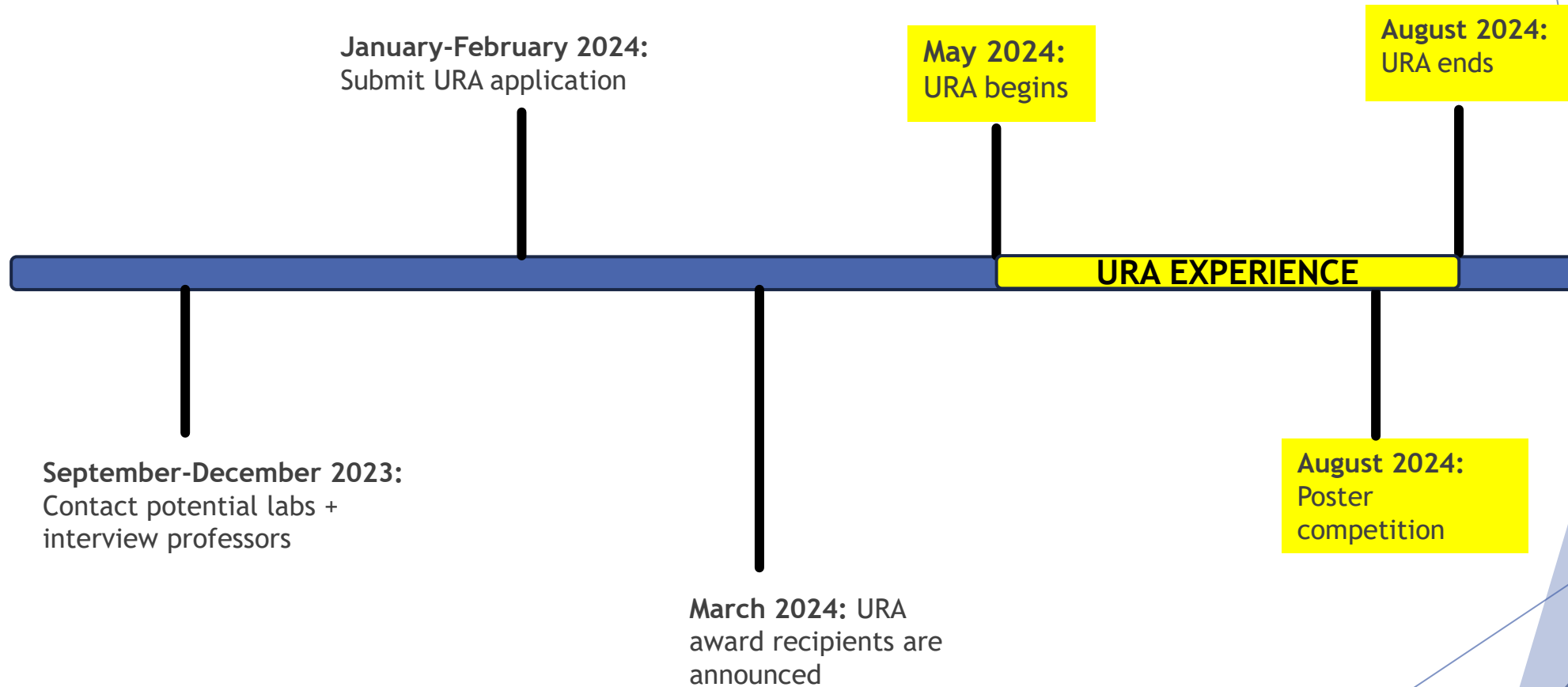


Inhibition of drug uptake



By employing electrochemical techniques, the main goal of my research is to detect the TOB retention in *E. coli* cells with different degrees of resistance.

# URA experience timeline:



# Tips for interviewing potential research supervisors:

- ▶ When interviewing potential supervisors, some questions you may want to ask include:
  - ▶ What would my research project focus on?
  - ▶ What does a day in the lab look like? Are the hours flexible?
  - ▶ Can I take summer classes while doing a URA?
  - ▶ How many other students will be working in the lab? Will I be working individually/or in a group?
  - ▶ How many post-docs and Ph.D students work in the lab?
  - ▶ What growth opportunities does this lab offer me?

\*The goal is to ask questions that will help you decide if the lab is a good fit for you, your goals, and your other commitments.



Group photo at the 2023 Summer Research Poster Competition

Feel free to take a photo of these questions! 😊



# How do you receive a URA?

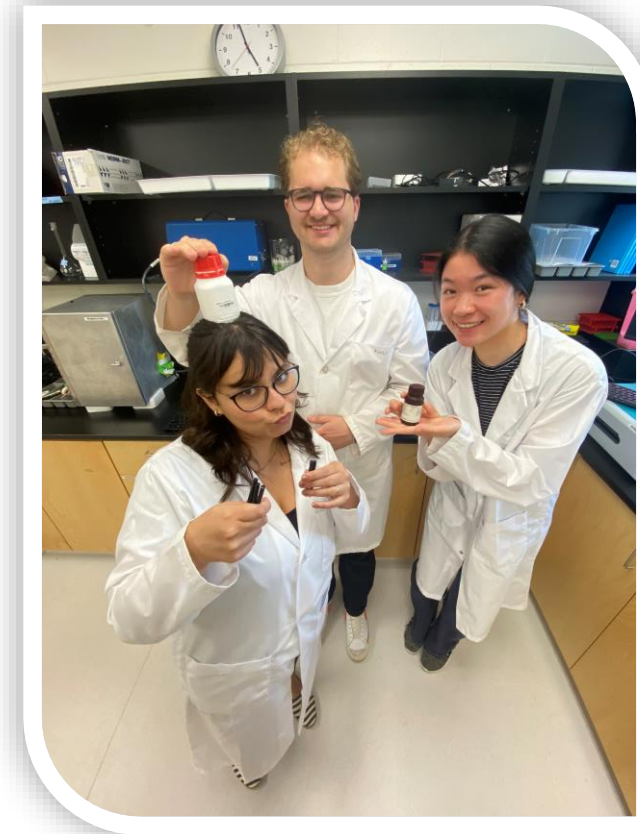
- ▶ Awards are heavily dependent on your GPA (min. 3.0-3.5)
- ▶ Contacted 11 professors (U of M, St. Boniface Research)
  - ▶ Interviewed 4 professors
  - ▶ \*Some professors at more advanced labs may require prerequisite knowledge or experience!
- ▶ **IF YOU ARE A FIRST-YEAR STUDENT:** you will most likely only be eligible for the URA, and not the USRA, NSERC, etc.
  - ▶ \*Make sure you read the eligibility requirements carefully!



# A typical day of summer research:

- ▶ 9:30 am: Arrive at the lab
- ▶ 9:30am-12:00pm: Conduct experiments, treat data, read articles for background information, meet with Dr. Kuss to discuss my progress, etc.
- ▶ 12:00pm-12:30pm: Lunch (group lunches in the Science Lounge!)
- ▶ 12:30pm-4:30pm: Finish experiments, other tasks as needed, etc.

\*I also took 2 summer classes and worked part-time in retail throughout my URA summer research experience.



# Why did I choose to work at Dr. Sabine Kuss' Lab?

Some URA Summer 2023 memories!



Celebrating Yaser's (Ph.D candidate) birthday!



Research team drawn by me!

- ▶ Interesting project
- ▶ Opportunities for growth
- ▶ Great mentors and learning environment
- ▶ Convenient location
- ▶ Flexible hours



Celebrating Dr. Kuss' birthday!



End of summer research celebration!





**Connect with our research group!**

Website: [www.bioanalyticschemistry.com](http://www.bioanalyticschemistry.com)

Twitter: @LBES\_UofM

# Thank you!